

REMARKS

Lined Out Reference in 4/28/06 IDS

Accompanying the 6/2/06 Office Action was a copy of Applicants' 4/28/06 Information Disclosure Statement in which the Examiner unambiguously indicated consideration all but one of the references. The exception is unpublished U.S. Application Serial No. 11/204,517. The Examiner placed her initials (by hand) next to the listing of the reference, but lined out the reference listing itself.

In order to avoid any possible ambiguity about whether the reference was considered, Applicants are submitting herewith an Information Disclosure Statement listing unpublished U.S. Application Serial No. 11/204,517. Applicants respectfully request consideration of the reference and unambiguous acknowledgment of that consideration.

Support for Claim Amendments

Claim 1 has been amended to recite that the polycyclooctene is synthesized "by ring-opening metathesis polymerization". Support for this amendment may be found in the last paragraph on page 3 of the application as filed.

Claim 1 has been further amended to separate the "cis-cyclooctene" monomer limitation from the "high trans double bond content" polymer limitation. Both limitations were present in claim 1 as filed. Although the original claim was clear, these amendments emphasize the distinctness of the monomer and polymer limitations.

Claims 9 and 10, which recite melting enthalpy limitations, have been amended to move the melting enthalpy units (joules per gram) next to the melting enthalpy values. Support for the expression of units as "joules per gram" may be found in the respective claims as filed, as well as in the units " J g^{-1} " used in the last column heading of Table 2 on page 10 of the application as filed.

Obviousness Rejection over (Grubbs or Tsunogae) + (Dragutan or Demonceau or Sato)

Claims 1-13, 15, and 22-24 stand rejected under 35 U.S.C. § 103(a), as allegedly unpatentable over U.S. Patent No. 5,728,785 to Grubbs et al. (“Grubbs”) or U.S. Patent No. 6,713,154 B1 to Tsunogae et al. (“Tsunogae) in view of Dragutan et al. in Polymer Preprints (“Dragutan”) or Demonceau et al. in J. Mol. Catalysis (“Demonceau”) or Sato et al. in J. Macromol. Sci-Chem (“Sato”). Applicants respectfully traverse this rejection to the extent it may be applicable to the claims as amended.

Grubbs generally describes methods of forming polycycloolefins having high crosslink density. Grubbs abstract. Olefins are polymerized via a metathesis mechanism in the presence of a crosslinking agent and a catalyst. *Id.* The crosslinking agent generally comprises a peroxide that decomposes into reactive species forming crosslinks during post-cure. *Id.* Grubbs does not teach polymers of cis-cyclooctene or the use of his compositions as shape memory compositions.

Tsunogae generally describes an insulating material comprising a cycloolefin polymer, specifically, an interlayer insulating material for a high-density assembly board, comprising a cycloolefin polymer containing at least 50 mol % of a repeating unit derived from a cycloolefin monomer; a dry film formed from a curable resin composition comprising a polymer having a number average molecular weight within a range of 1,000 to 1,000,000 as measured by gel permeation chromatography, and a hardener; and a resin-attached metal foil obtained by forming a film of a cycloolefin polymer on one side of a metal foil. Tsunogae abstract. Tsunogae teaches the use of cyclooctene to form addition polymers (not ring-opening polymers). Tsunogae does not teach shape memory polymers.

Dragutan generally describes controlling stereoselectivity in ring-opening metathesis polymerization of monocyclic olefins catalyzed by tungsten-based systems. Dragutan title. Polymerization of cyclooctene was studied. Dragutan, page 363, Table 5. Dragutan does not teach crosslinked polymer compositions or shape memory polymers.

Demonceau generally describes ruthenium-catalyzed ring-opening metathesis polymerization of cycloolefins initiated by diazoesters. Demonceau title. Polymerization of cyclooctene was studied. Demonceau, pages 127-129. Demonceau does not teach crosslinked polymer compositions or shape memory polymers.

Sato generally describes polymerization of cyclooctene and 5-substituted cyclooctenes with tungsten and molybdenum catalysts. Sato abstract. Sato does not teach crosslinked polymer compositions or shape memory polymers.

Applicants respectfully assert that their claims are patentable over the cited references for at least three reasons. First, the cited references fail to teach all compositional limitations of claim 1. Specifically, the cited references fail to teach a crosslinked ring-opening metathesis polymer of cis-cyclooctene. Second, the phrase “shape memory polymer” is a limitation that distinguishes Applicants’ claims from the cited references. Third, Applicants’ experimental results demonstrate the criticality of selecting a polycyclooctene having a high trans double bond content.

1. Cited References Do Not Teach All Claim 1 Compositional Limitations

The Office Action states,

US 5,728,785 to Grubbs et al. discloses a process of producing polycycloolefin having high crosslink density. Suitable monomer includes monocyclic olefins. Prior art specifically teach curing polymer formed from metathesis reaction at elevated temperature in the presence of peroxide crosslinking agents (col. 3, line 26 to col. 4, line 16).

US 6,713,154 to Tsunogae et al. discloses a process of producing a curable cycloolefin polymer composition with utility as insulating materials. Suitable monomer includes monocyclic cycloolefin monomer such as cyclooctene (col. 9, line 41). Prior art curable cycloolefin polymer composition is formed in the presence of a peroxide hardener (col. 13, line 28 to col. 14, line 4).

US-785 and US-154 are silent regarding the utility of the crosslinked polycyclooctene as shape memory polymer as recited in the preamble in the present claims. The examiner is of the position that such utility/properties associated with the utility would be considered inherent

in prior art crosslinked polycyclooctene, absent evidence that the respective polycyclooctene do in fact differ. [* * *]

6/2/06 Office Action, page 2-3. The rejection thus appears to be based on the premise that the primary references Grubbs and Tsunogae each satisfy the compositional limitations of Applicants' claims. Applicants respectfully submit that this premise is not supported by the references.

Applicants respectfully assert that the cited references do not teach or suggest all the compositional limitations of amended claim 1. For an obviousness rejection to be proper, the Examiner must meet the burden of establishing a prima facie case of obviousness. *In re Fine*, 5 U.S.P.Q.2d 1596, 1598 (Fed. Cir. 1988). Establishing a prima facie case of obviousness requires that all elements of the invention be disclosed in the prior art. *In re Wilson*, 165 U.S.P.Q. 494, 496 (C.C.P.A 1970). Applicants' currently amended claim 1 is reproduced below.

1. (currently amended) A shape memory polymer comprising chemically cross-linked polycyclooctene; wherein the polycyclooctene is synthesized from by ring-opening metathesis polymerization of cis-cyclooctene; wherein the polycyclooctene having has a high trans double bond content; and wherein the chemically cross-linked polycyclooctene is used as a shape memory polymer.

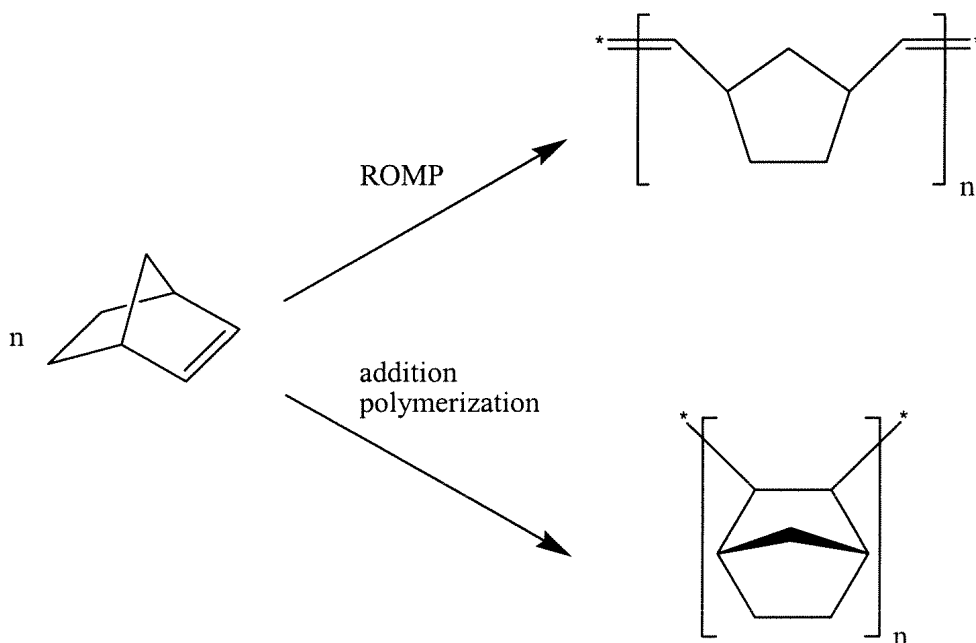
Note that the polycyclooctene is synthesized from cis-cyclooctene by ring-opening metathesis polymerization.

The first primary reference, Grubbs, does not teach or suggest a polycyclooctene synthesized from cis-cyclooctene. Grubbs' only mention of cyclooctene of any kind is in the background section, where trans-cyclooctene is mentioned as an example of a strained olefin that can be polymerized by particular prior art ruthenium carbene complexes. Grubbs, col. 2, line 43. For his own inventive process Grubbs does not mention the use of any cyclooctene, let alone cis-cyclooctene. Instead, Grubbs repeatedly teaches a preference for the use of norbornene, norbornene derivatives, and dicyclopentadiene as monomers for use in his process. *See, e.g.*, Grubbs abstract; col. 3,

lines 21-25; col. 5, lines 26-28 and 32-36; Examples 1-5 at col. 5, line 64 to col. 7, line 23; claims 7, 8, 14, 15, 19, 20. Grubbs thus fails to teach or suggest the use of a polycyclooctene synthesized from cis-cyclooctene, as required by Applicants' claim 1.

Applicants also note that Grubbs fails to teach or suggest the use of dicumyl peroxide, as required by Applicants' claim 2. Instead, Grubbs teaches a preference for certain alkyl peroxides. Grubbs, col. 5, lines 39-50.

The second primary reference, Tsunogae, does not teach or suggest a ring-opening metathesis polymer of cyclooctene, as required by Applicants' claim 1. Instead, Tsunogae teaches a chemically distinct addition polymer of cyclooctene. To understand this distinction, one must first appreciate that ring-opening metathesis polymerization and addition polymerization yield different polymer products. This principle is illustrated in the context of norbornene polymers in C. Janiak et al., Journal of Molecular Catalysis A: Chemical, 166 (2001), 193-209 ("Janiak"), submitted herewith. (Note that Janiak teaches the equivalence of the terms "vinyl-type polymerization" and "addition polymerization" but prefers to use the former term. Janiak, p. 2, end of paragraph bridging the two columns.) As shown in Janiak and depicted in the scheme below, ring-opening metathesis (ROMP) produces a polymer in which the monomer is ring-opened and the main polymer chain contains one carbon-carbon double bond per monomer.



In contrast, addition polymerization produces a product in which all of the monomer's rings are preserved and the main polymer chain contains only carbon-carbon single bonds. Thus, ROMP and addition polymerization produce chemically distinct polymer products. Tsunogae clearly appreciates the distinction between ROMP and addition polymerization. In describing suitable cycloolefin polymers, Tsunogae mentions six classes of cycloolefin polymers and characterizes five of the classes as relating either to addition polymers or ROMP polymers. Tsunogae, col. 6, lines 42-63 (the sixth class is simply hydrogenated products of the other five classes). The polymers classes are characterized not only according to polymerization method, but also according to monomer type. It is important to note that monocyclic cycloolefin monomers are mentioned only in the context of addition polymers, and that cyclooctene is disclosed only as an example of a monocyclic cycloolefin monomer. Tsunogae, col. 6, lines 53-56; col. 9, lines 37-44. Therefore, when the complete disclosure of Tsunogae is considered, as it must be, it is clear that the only polycyclooctene disclosed by Tsunogae is an addition polymer of cyclooctene. Tsunogae thus fails to teach or suggest a ring-opening polymer of cis-cyclooctene, as required by Applicants' claim 1.

The two primary references, Grubbs and Tsunogae, thus fail to teach or suggest Applicants' claim 1 ring-opening polymer of cis-cyclooctene. The secondary references cannot cure this deficiency. To the extent that Dragutan, Demonceau, and Sato might disclose ring-opening metathesis polymers of cyclooctene, there was no motivation for a skilled artisan to substitute these polymers in the methods of Grubbs and Tsunogae, thereby contradicting the express teachings of those primary references. "The consistent criterion for determination of obviousness is whether the prior art would have suggested to one of ordinary skill in the art that [the proposed modification] should be carried out and would have a reasonable likelihood of success, viewed in the light of the prior art." *In re Dow Chemical Co.*, 837 F.2d 469, 473 (Fed. Cir. 1988). "Both the suggestion and the expectation of success must be founded in the prior art, not in the applicant's disclosure." *Id.* Applicants respectfully submit that the cited art provide neither a suggestion of nor an expectation of success for the substitution of ring-opening metathesis polymers of cis-cyclooctene into the methods of Grubbs or Tsunogae.

2. “Shape Memory Polymer” is a Limitation and is Not Taught by the References

Applicants respectfully submit that the claim 1 term “shape memory polymer” is a limitation and that this limitation is not taught by the cited references.

The Office Action states,

US-785 [Grubbs] and US-154 [Tsunogae] are silent regarding the utility of the crosslinked polycyclooctene as shape memory polymer as recited in the preamble in the present claims. The examiner is of the position that such utility/properties associated with the utility would be considered inherent in prior art crosslinked polycyclooctene, absent evidence that the respective polycyclooctene do in fact differ. Furthermore, it is well known that the intended use clause found in the preamble is not afforded the effect of a distinguishing limitation unless the body of the claims set forth limitation that refers to the specific environment or use specified in the preamble. * * *

6/2/06 Office Action, page 3, second full paragraph.

First, Applicants respectfully disagree with the Examiner’s statement that, “it is well known that the intended use clause found in the preamble is not afforded the effect of a distinguishing limitation unless the body of the claims set forth limitation that refers to the specific environment or use specified in the preamble”. There is no such black and white test for whether a preambular phrase functions as a claim limitation. *See, e.g.,* MPEP 2111.02 (“there is no litmus test defining when a preamble limits the scope of a claim”). Instead, “a claim preamble has the import that the claim as a whole suggests for it.” *Bell Communications Research, Inc. v. Vitalink Communications Corp.*, 55 F.3d 615, 620, 34 USPQ2d 1816, 1820 (Fed. Cir. 1995). “If the claim preamble, when read in the context of the entire claim, recites limitations of the claim, or, if the claim preamble is ‘necessary to give life, meaning, and vitality’ to the claim, then the claim preamble should be construed as if in the balance of the claim.” *Pitney Bowes, Inc. v. Hewlett-Packard Co.*, 182 F.3d 1298, 1305, 51 USPQ2d 1161, 1165-66 (Fed. Cir. 1999). Applicants respectfully assert that the preambular term “shape memory polymer” in their claim 1 as filed is a claim limitation because it is necessary to “give life, meaning, and vitality” to the claim. However, in order to avoid any ambiguity and expedite prosecution,

Applicants have amended claim 1 to expressly include the “shape memory polymer” limitation in the body of the claim. Applicants also note that “shape memory polymer” was in the body of independent claims 22-24 as filed and that the term “shape memory polymer” is a limitation in the body of independent claim 15 via the incorporation by reference of claim 1. Thus, all rejected claims include a shape memory polymer limitation.

As conceded by the Examiner, Grubbs and Tsunogae do not teach or suggest the utility of a crosslinked polycyclooctene as a shape memory polymer. 6/2/06 Office Action, page 3, second full paragraph. Moreover, because Grubbs and Tsunogae do not teach ring-opening polymerized cis-cyclooctene, they cannot teach any utility for its crosslinked derivative. The secondary references do not remedy this deficiency. Dragutan, Demonceau, and Sato all relate to cycloolefin polymerization and do not mention crosslinked polycycloolefins, let alone any utility of such crosslinked polycycloolefins.

Furthermore, Applicants respectfully disagree with the assertion that any possible utility of a composition is inherent in that composition. If that assertion were true, it would not be possible to patent a new use of a known compound. That is clearly not the case. *See, e.g.*, MPEP 2112.02. Use of a composition as a shape memory material clearly requires manipulations of the composition that are not inherent in the composition itself. Specifically, to be employed as a shape memory polymer, a polymer composition must be formed into an article that has both a temporary shape and a different equilibrium shape that is recoverable from the temporary shape under thermal, electrical and/or environmental stimulus. Present application, page 1, second paragraph. For example, the temporary shape necessary for shape memory behavior may be created by first creating an article with a permanent shape, heating the article above the shape transition temperature, deforming the article into a temporary shape, and cooling the article below the shape transition temperature while maintaining the temporary shape. *See, e.g.*, present application, paragraph bridging pages 14 and 15. Shape memory behavior thus requires manipulations that are not inherent in the polymer composition itself.

In summary, all of the rejected claims include a “shape memory polymer” limitation, and none of the cited references teaches that limitation, either expressly or inherently. Accordingly, a prima facie case of obviousness has not been established.

3. Applicants Have Demonstrated the Criticality of a High Trans Content

Applicants respectfully assert that the working examples in the application as filed support the criticality of selecting a polycyclooctene with a high trans double bond content.

Claim 1 as originally filed and as currently amended includes the limitation that the polycyclooctene has “a high trans double bond content”. Claim 32, added in Applicants’ 3/20/06 Amendment, includes the limitation that “the polycyclooctene has a trans double bond content of about 68 to about 81%”.

The Office Action states,

Regarding the choice of cis-cyclooctene having high trans double bond content, the examiner is of the position that it would have been obvious to one skilled in the art to carried out via experimental control such as choice of catalyst, monomer concentration, temperature, solvent media, and reaction time, as expressly shown in the ancillary references. Absent showing of criticality and/or unexpected results shown for the 68 to about 81% trans double bond content recited in claim 32, the examiner is of the position that discovering the optimum or workable ranges within the guideline of prior art general disclosure would involve only routine skill in the art. Accordingly, one having ordinary skill in the art would readily envisage the synthesis of crosslinked polycyclooctene shape memory polymer as taught, sufficiently motivated by the reasonable expectation of success.

6/2/06 Office Action, paragraph bridging pages 3 and 4.

First, as noted above, neither of the primary references teaches ring-opening polymerized cis-cyclooctene, and there is no motivation for one of ordinary skill in the art to substitute such a polymer for the other polymers expressly taught by the primary references. So, obtaining Applicants’ claimed invention is not a simple matter of optimizing a composition taught in the primary references, as the Examiner suggests.

Second, even if there were a motivation to utilize ring-opening polymerized cis-cyclooctene in the inventions of Grubbs and Tsunogae (which Applicants dispute), the cited references provide no motivation to select a polycyclooctene with a high trans double bond content. The Examiner's reference to "discovering the optimum or workable ranges" appears to assume that the skilled artisan is motivated to optimize shape memory behavior, but no such motivation is provided by the references. As noted above, not one of the cited references mentions shape memory behavior. And the Examiner has provided no other motivation for selecting polycyclooctene with a high trans double bond content. The cited references therefore provide no motivation for one of ordinary skill in the art to select a polycyclooctene with a high trans double bond content.

Third, the working examples in the present application demonstrate the criticality of a high trans double bond content. Specifically, the data in Table 1 on page 9 show that only polycyclooctenes having a high trans double bond content exhibit a melting temperature substantially above room temperature. Specifically, polycyclooctenes having trans double bond contents of 68%, 78%, and 81% exhibit melting temperatures of 41°C, 55°C, and 60°C, respectively. As explained in the application, a melting temperature substantially above room temperature is important because it allows the temporary shape to be fixed by cooling to room temperature and it prevents loss of the temporary shape by partial or complete melting at room temperature. Present application, end of paragraph bridging pages 12 and 13. Applicants have therefore demonstrated a surprising, useful, and previously unrecognized advantage to selecting polycyclooctenes having a high trans double bond content. This showing is sufficient to support the criticality of the claim 1 and claim 32 limitations directed to trans double bond content.

4. Summary

For all of the above reasons, the Office has failed to establish a prima facie case of obviousness, and Applicants' claims are patentable over the cited references. Accordingly, Applicants respectfully request the reconsideration and withdrawal of the

rejection of claims 1-13, 15, and 22-24 under 35 U.S.C. § 103(a) over Grubbs or Tsunogae in view of Dragutan or Demonceau or Sato.

Citation of Griffin

The 6/2/06 Office Action mentions U.S. Patent Application Publication No. 2003/0114777 A1 of Griffin et al. (“Griffin”) as “made of record”, “not relied upon”, and “considered pertinent to applicant’s disclosure”. 6/2/06 Office Action, page 4, paragraph no. 3. Specifically, the Office Action states that Griffin “is hereby made of record to show the known utility of polycyclooctene as shape memory polymer”. *Id.*

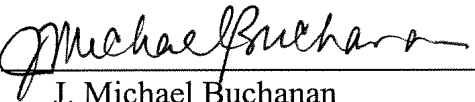
Applicants respectfully disagree with the Examiner’s characterization of Griffin. The Examiner’s statement ignores the difference between polycyclooctene, as disclosed by Griffin, and crosslinked polycyclooctene as claimed by Applicants. Note, in particular, that Griffin mentions “cross-linked polyethylene” and “cross-linked polyisoprene”, but in the same paragraph polycyclooctene is mentioned without being described as “crosslinked”. Griffin, page 2, paragraph [0013]. Griffin therefore does not teach or suggest the use of crosslinked polycyclooctene in any capacity. It follows that Griffin does not teach or suggest any utility of crosslinked polycyclooctene.

It is believed that the foregoing amendments and remarks fully comply with the Office Action and that the claims herein should now be allowable to Applicants. Accordingly, reconsideration and allowance is requested.

If there are any additional charges with respect to this Amendment or otherwise, please charge them to Deposit Account No. 06-1130 maintained by Applicants' Attorneys.

Respectfully submitted,

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